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Evaluation of Quasi-Static and Computational Solutions of Phase Change with Internal Heat Generation JOHN CREPEAU, University of Idaho, ALI SIAHPUSH, Idaho National Laboratory, BLAINE SPOTTEN, University of Idaho — During a solid-liquid phase change, the internal heat generation of the material enhances the melting process and impedes solidification. Previously presented results have given an approximate, closed form solution of this problem, using a quasi-static method, valid for Stefan numbers less than one. It was shown that the steady-state location of the front was inversely proportional to the square root of the internal heat generation. To test the validity of the quasi-static solution, a computational fluid dynamics model was developed, and the results were compared to the closed-form solution. A cylindrical geometry was chosen, with both constant temperature and constant heat flux boundary conditions. For the constant temperature boundary condition, there was excellent agreement between the quasi-static and computational solutions for Stefan numbers less than one, validating the approximate solution technique. The agreement between the two methods diverged for Stefan numbers of one and greater, with the approximate solution reaching steady-state faster than the computational solution. For the constant heat flux boundary condition, there was excellent agreement between the approximate and computational solutions when the ratio between the volumetric internal heat generation and surface heat flux was close to one.

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